Population Growth Equations Practice Worksheet

Key

Formulas:

Rate	Population Growth	Exponential Growth	Logistic Growth
dY/dt	dN/dt = B – D	$\frac{dN}{dt} = r_{max}N$	$\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$

Key

dY = amount of change

B = birth rate (#of organisms born / 1 year)

D = death rate (# of organisms died / 1 year)

N = population size (# of organisms in the population)

K = carrying capacity (maximum number of organisms that the environment can sustain)

r_{max} = maximum per capita growth rate of population (decimal value, a value of 1 means that the population size is doubling or increasing by 100% each year)

$\frac{dN}{dt} = \frac{\Delta N}{\Delta t} = \frac{change\ in\ population\ size}{change\ in\ time}$ = number of organisms added per unit time (ex: per year)

Example 1:

There are 300 falcons living in a certain forest at the beginning of 2013. Suppose that in 2013, there are 50 falcons born and 30 falcons that die.

a. What is the population growth rate for the population in 2013 (include units)? What does this value mean?

$\frac{\Delta N}{\Delta t} = B - D = 50 - 30 =$ 20 falcons added in 1 year

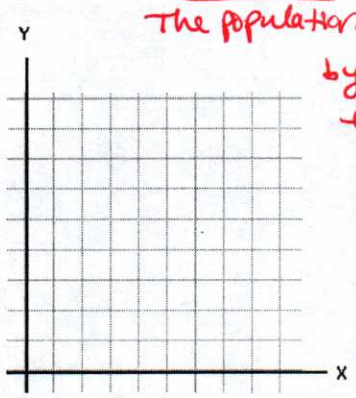
b. What is the per capita growth rate of the falcons over a year? What does this value mean?

r_{max} $\frac{\Delta N}{\Delta t} = r_{max}N \rightarrow \frac{20}{300} = \frac{r_{max} \cdot 300}{300} =$ 0.067

The population increases by 6.7% each year

c. Fill in the table and the construct a graph.

Year	Calculation	Population Size (N)
2013	N/A	300
2014	300 + 20	320
2015	(0.067)(320) = 21 + 320	= 341
2016	(0.067)(341) = 23 + 341	= 364
2017	(0.067)(364) = 24 + 364	= 388
2018	(0.067)(388) = 26 + 388	= 414



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d. Find the average rate of change for the falcon population from 2013 to 2018 (include units). What does this value mean?

$\frac{dY}{dt} = \frac{414 - 300}{2018 - 2013} =$ 23 falcons per year

over 5 years, the falcon population increased by 23 falcons per year on average

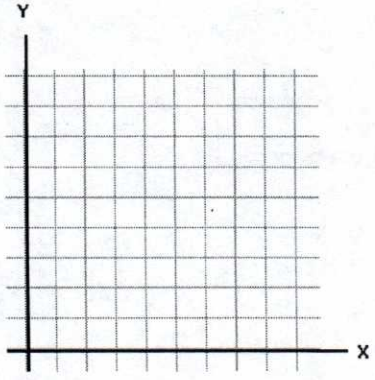
Indicates that you need to use the logistic growth equation... $\frac{dN}{dt} = r_{max} N \left(\frac{K-N}{K}\right)$

Example 2:

Kentwood, Michigan had a population of 49,000 in the year 2013. The infrastructure of the city allows for a carrying capacity of 60,000 people. r_{max} = .9 for Kentwood.

a. Fill in the following table. Then graph year vs. population size.

Year	Population size (N)	Growth Calculation	Population growth rate (dN/dt)
2013	49,000	$\frac{dN}{dt} = (0.9)(49,000)\left(\frac{60,000-49,000}{60,000}\right)$	= 8085
2014	57,085	$\frac{dN}{dt} = (0.9)(57,085)\left(\frac{60,000-57,085}{60,000}\right)$	= 2496
2015	59,581	$\frac{dN}{dt} = (0.9)(59,581)\left(\frac{60,000-59,581}{60,000}\right)$	= 374
2016	59,955	$\frac{dN}{dt} = (0.9)(59,955)\left(\frac{60,000-59,955}{60,000}\right)$	= 40
2017	59,995	$\frac{dN}{dt} = (0.9)(59,995)\left(\frac{60,000-59,995}{60,000}\right)$	= 4



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N

b. What happened to the population size over the years? What happened to the population growth rate over the years? Use the term carrying capacity in your response.

The population size increased over the years but the population growth rate decreased as the population size approached its carrying capacity.

$\frac{dN}{dt}$

K